Physics 230 - Intermediate Dynamics
Fall 2017
Professor: Dr. Chad A. Middleton

Classroom	Wubben Hall 117
Class Hours	2-2:50 MON, WED, & FRI
Office	Wubben Hall 228A
Office Hours	1-2:00 MON & WED
	11-12:00 TUE & FRI
	9-10:00 THU
Office Phone	970-248-1173
Email	chmiddle@coloradomesa.edu
Webpage	www.coloradomesa.edu/~chmiddle/230/

Required Texts:

- *Physics for Scientists and Engineers: A Strategic Approach, Vol. 2 (Chs. 16-19)* by Randall Knight, 3/E, Pearson (ISBN: 978-0-321-75318-2)
- *Vibrations and Waves* by George King, Wiley (ISBN: 978-0-470-01189-8)
- *Special Relativity* by T.M. Helliwell, University Science Books (ISBN: 978-1-891389-61-0)

Course Description:

This course covers the topics of *fluid dynamics and thermodynamics*, *Einstein's theory of special relativity*, and *vibrations and waves*. The first topic covered, *fluid dynamics and thermodynamics*, will follow the treatment presented in Knight's text and have a feel of "Physics Part III". We will then move on to *Einstein's theory of special relativity*, which will shake your very notion of physical reality and change your preconceived ideas about space and time. At this point, the course will evolve from an introductory physics course to one of more sophistication. Although mathematically elementary, involving mostly algebra, you will find special relativity to be conceptually challenging (to say the least!). We will then spend the last third of the course studying *waves and vibrations* where we will sophisticate the mathematics substantially.

From the catalog…
"Intermediate treatment of the dynamics of physical systems not covered in Fundamental Mechanics sequence. Includes fluid dynamics, classical waves and vibrations, thermodynamics, and relativistic kinematics and dynamics. Prerequisites: PHYS 132, 132L, and MATH 253 (may be taken concurrently)."
Source: 2017-2018 CMU Catalog, pp. 232

Course Expectations:
An undergraduate student should expect to spend on this course a *minimum of two hours outside the classroom for every hour in the classroom*. The outside hours may vary depending on the number of credit hours or type of course. More details are available from the faculty member or department office and in CMU's *Curriculum Policies and Procedures Manual*.

Intermediate dynamics is inherently mathematical by its very nature. A true understanding of intermediate dynamics will be realized *only* after you, the student, actually *do* intermediate dynamics (i.e. homework and exam problems). You should treat every homework problem as a test of your understanding of the subject material. The homework sets will be quite long and will require many hours of work. It will not be unusual for you to spend *six hours or more* on a

homework set. Hard work will be demanded from you in this course!

Course Requirements:
Assignments

- There will be roughly one assignment per week consisting of approximately 4-8 homework problems per assignment. Assignments are to be turned in by 5 pm on the date due. Late assignments will be penalized by a 10% grade reduction each day they are late.

- You are encouraged to discuss homework problems with your classmates. Working problems with your peers is an excellent learning method, however, anything turned in **must** be your own work.

Examinations

- There will be two midterm exams during the semester and a final exam. Each exam will consist of an in-class section and/or a take-home section.

Grading:
Your grade for this course is based on the following activities, weighted as shown

Homework Assignments	*40%*
Midterm Exams (2)	*40% (20% each)*
Final Exam	*20%*

Grading Scale:
· All graded work will be assigned a numerical score. You may estimate the corresponding letter grade by computing a percentage score and comparing it with the table below:

Percentage Score	Letter Grade	Percentage Score	Letter Grade
90-100	A	60-69	D
80-89	B	Below 60	F
70-79	C		

Attendance:
· Regular class attendance is **strongly** recommended. You are responsible for all material discussed in class. It is in your best interest to *always* attend class and arrive on time – this class begins promptly at 2:00 pm!

Accommodation for Students with Physical and Learning Disabilities:

In coordination with Educational Access Services, reasonable accommodations will be provided for qualified students with disabilities. Students must register with the EAS office to receive assistance. Please meet with the instructor the first week of class for information and/or contact Dana VandeBurgt, the Coordinator of Educational Access Services, directly by phone at 248-1801, or in person in Houston Hall, Suite 108.

Course Learning Objectives:

A student who has taken this course will demonstrate the ability to:

1. Translate between verbal and mathematical descriptions of physical situations. Apply mathematical reasoning, using algebra, trigonometry and calculus, to analyze these situations.
2. Describe physical systems via differential equations and solve these.
3. Use complex number algebra to analyze physical situations.
4. Describe and use fundamental concepts from fluid dynamics such as density, pressure, Archimedes principle, Pascal's principle, the equation of continuity and Bernoulli's equation.
5. Describe and use the zeroth, first and second laws of thermodynamics, particularly for ideal gasses.
6. Describe macroscopic properties of thermodynamic systems and use kinetic theory to relate them to microscopic properties.
7. Relate thermodynamic properties to measurable quantities such as specific heats and use these in calorimetry problems.
8. State Einstein's postulates for special relativity.
9. Relate observations in different frames of reference using time dilation, length contraction, Lorentz transformations, and spacetime diagrams.
10. Describe and use relativistic energy and momentum.
11. Describe and use fundamental concepts associated with oscillations and waves such as period, frequency, wavelength and amplitude.
12. Obtain and solve differential equations of motion for oscillatory systems and use these to extract periods.
13. Describe and solve the classical wave equation and apply these to traveling and standing waves.
14. Describe superposition and interference effects for classical waves.

Program-Level Student Learning Objectives:

This course satisfies the following Physics-degree student learning objectives:

1. Show fluency with the major fields of physics (classical mechanics, electromagnetism, statistical physics and quantum theory).
2. Use mathematical representations to analyze physical scenarios. This requires translating back and forth between physical and mathematical problems and using appropriate mathematics to aid in the analysis of the scenario.

Course Calendar:

This is a TENTATIVE course calendar ONLY!! The actual course can (and most likely will) deviate from the calendar listed below.

Date	Subject
Mon, Aug 21	Syllabus discussion/Knight: Ch. 15 – Fluids & Elasticity
Wed, Aug 23	Knight: Ch. 15 – Fluids & Elasticity
Fri, Aug 25	Knight: Ch. 15 – Fluids & Elasticity
Mon, Aug 28	Knight: Ch. 16 – A Macroscopic Description of Matter
Wed, Aug 30	Knight: Ch. 16 – A Macroscopic Description of Matter
Fri, Sep 1	Knight: Ch. 16 – A Macroscopic Description of Matter
Mon, Sep 4	Knight: Ch. 17 – Work, Heat, and the 1st Law of Thermodynamics
Wed, Sep 6	Knight: Ch. 17 – Work, Heat, and the 1st Law of Thermodynamics
Fri, Sep 8	Knight: Ch. 17 – Work, Heat, and the 1st Law of Thermodynamics
Mon, Sep 11	Knight: Ch. 17 – Work, Heat, and the 1st Law of Thermodynamics
Wed, Sep 13	Knight: Ch. 18 – The Micro/Macro Connection
Fri, Sep 15	Knight: Ch. 18 – The Micro/Macro Connection
Mon, Sep 18	Knight: Ch. 18 – The Micro/Macro Connection

Wed, Sep 20	Helliwell: Ch. 1 – Inertial Frames and Classical Mechanics
Fri, Sep 22	Helliwell: Ch. 2 – Light and the Ether
Mon, Sep 25	**EXAM 1 (Knight: Chapters 15 - 18)**
Wed, Sep 27	Helliwell: Ch. 3 – Einstein's Postulates
Fri, Sep 29	Helliwell: Ch. 4 – Time Dilation
Mon, Oct 2	Helliwell: Ch. 5 – Lengths
Wed, Oct 4	Helliwell: Ch. 6 – Simultaneity
Fri, Oct 6	Helliwell: Ch. 6 – Simultaneity
Mon, Oct 9	Helliwell: Ch. 7 – Paradoxes
Wed, Oct 11	Helliwell: Ch. 8 – The Lorentz Transformation
Fri, Oct 13	*Fall Break – No Classes*
Mon, Oct 16	Helliwell: Ch. 8 – The Lorentz Transformation /Ch. 9 – Spacetime
Wed, Oct 18	Helliwell: Ch. 9 – Spacetime
Fri, Oct 20	Helliwell: Ch. 9 – Spacetime
Mon, Oct 23	Helliwell: Ch. 10 – Momentum
Wed, Oct 25	Helliwell: Ch. 10 – Momentum/Ch. 11 - Energy
Fri, Oct 27	Helliwell: Ch. 11 - Energy
Mon, Oct 30	King: Ch. 1 – Simple Harmonic Motion
Wed, Nov 1	King: Ch. 1 – Simple Harmonic Motion
Fri, Nov 3	**Exam 2 (Helliwell: Chapters 1 - 11)**
Mon, Nov 6	King: Ch. 1 – Simple Harmonic Motion
Wed, Nov 8	King: Ch. 2 – The Damped Harmonic Oscillator
Fri, Nov 10	King: Ch. 2 – The Damped Harmonic Oscillator
Mon, Nov 13	King: Ch. 2 – The Damped Harmonic Oscillator
Wed, Nov 15	King: Ch. 3 – Forced Oscillations
Fri, Nov 17	*Board of Trustees Meeting – No Classes*
Mon, Nov 20	*Thanksgiving Break – No Classes*
Wed, Nov 22	*Thanksgiving Break – No Classes*
Fri, Nov 24	*Thanksgiving Break – No Classes*
Mon, Nov 27	King: Ch. 3 – Forced Oscillations
Wed, Nov 29	King: Ch. 3 – Forced Oscillations
Fri, Dec 1	King: Ch. 5 – Travelling Waves
Mon, Dec 4	King: Ch. 5 – Travelling Waves
Wed, Dec 6	King: Ch. 5 – Travelling Waves
Fri, Dec 8	*Final Exam Review*

Final Exam:** Monday, December 11 at 3 - 4:50 pm